Mitigating System Performance Index

What is the Mitigating System Performance Index (MSPI)?

The MSPI is a safety performance indicator for five important systems: Emergency AC, High Pressure Injection, Heat Removal, Residual Heat Removal, and Support Cooling.

Performance is determined by comparing the individual plant systems availability (is the system in service when it might be called upon?) and reliability (will it operate as expected?) against the industry average of acceptable performance.

The importance of the difference between the individual plant performance and the industry average is determined by applying a risk weight to each train of the system and to each risk significant component in the system.

The risk contribution of unavailability and unreliability are combined and the result is then compared to safety thresholds of performance, which the NRC uses to determine what level of additional inspection may be required above the baseline inspection to ensure safe performance. These thresholds match the thresholds NRC uses to determine the safety significance of its inspection findings.

Why do we need to replace the current Safety System Unavailability (SSU) indicator with MSPI?

The SSU was adopted by the Reactor Oversight Process because it was already being used by industry to provide information to the World Association of Nuclear Operations (WANO), and it provided a fairly good rough indication of system unavailability. However, from the beginning, industry and NRC realized that it did not adequately address the other half of system performance, the reliability of the equipment. Both industry and NRC agreed to begin work on a replacement indicator and the result is the MSPI. Other problems with the SSU included:

- "Fault exposure" unavailability was used as a surrogate for unreliability. Besides being an inadequate surrogate, trying to determine the correct fault exposure time required time consuming and extremely subjective analysis. The inadequacy, confusion, and wasted time were recognized two years ago when the most troubling type of fault exposure was removed from the performance indicators on the assumption that MSPI would be adopted in place of SSU. Using unreliability solves this problem, saving resources and producing quicker and more accurate results.
- Support system unavailability was "cascaded" onto the front line systems. This approach blurs the distinction between what system has performance problems, requires enormous effort to determine what systems are affected and in what configurations, and results in time consuming questions between industry and NRC.
- The SSU included definitions which differed from those used in the maintenance rule and in probabilistic risk studies, causing system engineers to develop wasteful separate sets of books to measure the same performance. The MSPI corrects this problem and will make it easier for licensees and the NRC to assess performance.

- The SSU unavailability is based on design basis assumptions, which may have minor or no safety significance in terms of risk. The MSPI will use maintenance rule and PRA assumptions which are actually used to operate and maintain the plants.
- The risk significance of individual trains was not considered; rather, train unavailability was simply averaged. This approach can mask safety insights or overemphasize issues of little safety significance.
- Thresholds of performance for the SSU were the same for all plants and therefore did not reflect the individual plant risk, nor did they take into account individual plant allowed outage times or planned maintenance schedules. MSPI will indicate plant specific increase in risk, thus being consistent with the maintenance rule and plant operations and maintenance activities. The thresholds will indicate set increases in risk and be perfectly aligned with the inspection finding assessment approach.

Isn't the MSPI very complicated?

No. The MSPI takes information already collected in the SSU, maintenance rule, or INPO's EPIX data base, compares it to industry baseline numbers, and applies a risk importance weight. The initial implementation will require some additional effort (estimated time required by the pilot plants is several person-weeks). Ongoing effort will be no more than the current effort for SSU, maintenance rule and EPIX.

The concern about complexity has to do with the rules for determining the risk importance weights. These issues are well understood by the PRA practitioners who will be developing the risk weights. Once a set of guidance has been agreed upon and training in the approach has been conducted, the PRA practitioners will have no problem developing the risk weights.

What information will the public get to see?

The NRC public website will continue to show color coded windows of performance as it does now. At the next level, it will continue to show charts of performance over time and the red, yellow, white and green thresholds of performance. Instead of showing the planned, unplanned, and fault exposure unavailable hours and the required hours, the MSPI will show the change in risk due to unavailability and the change due to unreliability. For those interested in determining how the indicator is calculated, the website will have a link to the Performance Indicator Guideline. Just as the current indicator does not display individual instances of equipment failure or train unavailability, the MSPI will not provide this level of detail. Members of the public interested in more detail can read the inspection reports which describe individual failures in the plant. The MSPI will also not include train or component risk factors. These are not part of the SSU at all, and will not be provided to the public. The dissemination of PRA information has been determined by the NRC to not be in the public interest. In conclusion, the public will be provided with information in the same format as before, but with additional information regarding the significance of changes in unavailability and new information on the significance of changes in unreliability.

Won't the NRC's inspection burden increase with MSPI?

No, ongoing inspection burden to validate performance indicators will be easier than today. Unavailability will be easier to check because it is only measured at power, it is consistent with maintenance rule data collection, and the complication of determining the effect of cascading will not be necessary. Unreliability consists of failures and demands which are also readily available. Furthermore, new industry software to consolidate equipment performance data collection and improve quality will further simplify data verification.

The initial data verification will require additional effort. This inspection will look at system boundaries, selection of components, success factors, historical data and the MSPI risk weight factors. Based on experience and lessons learned from the pilot program, this effort will not be overwhelming and in fact will enhance the inspectors ability to understand the risk significance of equipment and where they should focus their inspection efforts, making them more effective and efficient. Changes to the risk weight factors should not be changed on a frequent basis and should not add significant additional burden.

Last year, NRC inspectors expressed concern regarding the burden imposed by the significance determination process to assess failures which their intuition told them were of little safety significance, but their procedures required many hours of assessments using phase II notebooks. The MSPI will remove the need to conduct these low value add phase II assessments because single failures will be assessed using the MSPI.

Thus, overall, the MSPI should focus inspection resources on more risk significant issues without increasing inspection burden.

Will the NRC's ability to inspect be limited by the MSPI?

No. The NRC will continue to perform its baseline inspection program (and will likely have a better understanding of the risk significance of systems and components). Also, as is currently the case, NRC will continue to perform assessments of events using its Management Directive 8.3 which assesses the importance of events and assists NRC in determining what level of assessment team to employ.

When single failures of monitored equipment occur, the NRC will continue to assess the ongoing licensee corrective action, it will just be relieved of the need to conduct a time consuming phase II analysis. In fact, the MSPI may identify on ongoing failure problem which the phase II SDP is blind to. When more complicated failures occur (such as common cause or multiple concurrent failures) or failures are identified which could not be revealed in a surveillance test (such as a design deficiency which is not tested), the NRC will perform its SDP as it does now. Thus NRC will not be limited in its ability to oversee licensee performance in any way.

How do we know the risk importance weights are appropriate?

NRC and industry PRA experts are developing the guidance which will be used to calculate the risk importance weights for trains and components. The techniques involved must be consistently applied by all the plants. This will be accomplished through clear guidance, training, and assessment.

An important element in developing the appropriate risk weights is whether the PRA itself has been conducted in an appropriate manner. This is an issue which is not unique to the MSPI and applies to all PRA applications, ranging from maintenance rule, to allowed outage times, to license amendments, to proposed rulemaking. PRA quality has been reviewed at each nuclear power plant through industry peer reviews and in the future an ASME standard will be used. Since current PRA quality is acceptable for operating and maintaining plants, it should be considered acceptable for an "indicator" of performance. It should also be noted that the NRC uses its own Standardized Plant Assessment Reviews (SPAR) PRA models to assess inspection findings in the SDP. The NRC has determined that its SPAR models are, for the most part, less detailed than plant PRAs, primarily due to the lack of plant specific configuration information in the SPAR. When these aspects are added, the SPAR models and the plant PRAs come into close agreement, even at the component level. That being said, there may be some PRA issues which need to be addressed early in the implementation of the MSPI, but these changes do not appear to challenge the usefulness of the MSPI in its intended purpose of providing an indication of performance.

Will the MSPI improve the NRC's ability to meet its mission of maintaining safety?

The MSPI will provide a greatly improved indicator of mitigating system performance over the SSU. Inspection resources will not be increased and may in fact be able to focus on more important issues and components through the PRA insights gained from MSPI. Overall, NRC's ability to meet its mission of maintaining safety will increase.